Elementary Mathematics

The elementary mathematics section of this document has been written in an unique fashion. The writing team composed of primary and upper elementary educators chose to combine measurable performances and provide two levels of Sample Investigations. Otherwise, the measurable performances would have been repetitive and varied only in the degree of understanding and abstractness. During the child's elementary experience, some level of accomplishment of the measurable performances can be expected.

All students can learn mathematics by accommodating developmental differences. Research verifies that extensive exploration and discovery with manipulatives precedes abstract activities. All learners move from the concrete to the abstract. (Piaget, 1976)

Elementary Number Sense

Number sense is the relationship between numbers and operations. Students who demonstrate number sense have acquired the knowledge and skills necessary to represent numbers in a variety of ways, make realistic estimates when computing, and use correct processes for number operations. Students understand how numbers relate to each other and how they provide information about the real world.

Measurable Performances

The learner will:

- *Develop multiple strategies for number computations and share them with a peer.*
- *Describe and evaluate the role of place value in number systems.*
- *Justify appropriate number operations within various contexts.*
- *Use calculators, computers, and other technology effectively in problem solving situations.*

A Closer Look

The building of number sense begins informally before children enter elementary school. Guided study of number sense starts at the primary level with classroom exploration and activities. Attention to numbers in everyday life provides opportunities for exploration of number relationships with a variety of materials. Counting, adding and subtracting, comparing and classifying, and understanding the magnitude of numbers are major concepts which should be discussed on a daily basis.

As students develop, they need encouragement to model and describe numbers in a variety of ways and to make estimations. Students need a variety of experiences to understand when it is appropriate to estimate and when computational accuracy is necessary.

Students should extend their knowledge of numbers by being provided opportunities to estimate, verify predictions and quantities, and pose and solve meaningful questions. Students should continue to apply number sense and appropriate operations across the curriculum and to situations outside of school. Discussing their varying methods of arriving at reasonable answers allows students to grow in number sense.

Primary Sample Investigation
Keep track of school days and celebrate the 100th day of school. Students bring in 100 items. Investigate and compare student examples.

Upper Elementary Sample Investigation #1
Give consonants and vowels certain penny or dollar values and have students find the value of a word. Could be expanded to find the most expensive word, the most economical word, or to find words of a certain value.

Upper Elementary Sample Investigation #2
Encourage the development of a sense for the value of money. Have the class raise money for a worthwhile project by recycling aluminum cans. Collect data about the price per pound and how many cans per pound. Determine the amount of money they want to raise, figure the rate per day, and predict how long it will take.

Elementary Measurement

Measurement in the mathematics curriculum empowers children to see that mathematics is relevant in everyday life. Children will be actively involved in solving problems in their environment. Initial experiences in measurement need to include a variety of activities that focus on comparing objects and determining area with various units. Using standard and nonstandard units will develop some understanding about measurement as well as the necessity of standard units in order to communicate. Activities in visualizing units of measure will promote understanding of measurement concepts.

Measurable Performances

The learner will:

- *Explore, identify, and utilize appropriate measurement tools.*
- *Estimate, construct, and justify the solutions to problems using appropriate units of measure.*
- *Solve problems taken from actual situations which relate measurement concepts to other disciplines, and communicate the results effectively.*

A Closer Look

Children begin to communicate measurement through estimation. They need to develop estimation strategies and the accuracy required in any given situation. Children will understand the reasonableness of their answer through practice with estimation. A child will be better prepared to select the unit needed and the number of units in the object being measured. Measurement should focus on exploration, practical applications, and the use of appropriate tools. Geometry and measurement are interconnected and support each other.

Conceptual development of area, length, weight, time, temperature, money, and volume are initiated at the primary level. Exploration of the measurement concepts will allow the child to develop procedures and formulas. The focus of the curriculum should be on the development of understanding, not on the memorization of formulas.

Students should have experiences in nonstandard, metric, and English systems of measurement. The metric system is the standard unit of measurement in science. The metric measurement will reinforce place value, base ten, and decimals. When introducing the English measurement system, it should coincide with the introduction of fractions and rational numbers.

Primary Sample Investigation #1
Nonstandard measurement tools such as hands, paper clips, pencils, and shoes can be used to measure classroom objects.

Primary Sample Investigation #2
Measure shadows at various times of the day.

Primary Sample Investigation #3
Have children compare the volumes or capacities of containers.

Upper Elementary Sample Investigation #1
Using perimeter and area, measure an outdoor space, a business, or a classroom. Determine quantities of materials needed to landscape or furnish the area.

Upper Elementary Sample Investigation #2
Use the travel section of the newspaper, highway map, or other sources to determine the distance to a city using two different modes of transportation.

Upper Elementary Sample Investigation #3
Determine the height and weight requirements for various carnival rides. Predict and determine how many students would meet these requirements.

Elementary Spatial Relationships/Geometric Topics

Spatial relationships/geometric topics is the study of patterns and shapes. Students should visualize, draw, and compare shapes in various positions to help develop their spatial sense. This strand focuses on investigating and using geometric ideas and relationships. Students should identify and compare attributes of geometric figures. Measurement is an integral part of geometric topics.

Measurable Performances

The learner will:

- *Explore, explain, model, and classify shapes.*
- *Measure and compare geometric figures.*
- *Identify multi-dimensional shapes in real situations.*
- *Create geometric figures using appropriate tools.*
- *Communicate geometric topics with relevant vocabulary.*

A Closer Look

Experiences need to begin with familiar objects and concrete materials to develop an understanding of geometry. Manipulatives need to be used at all levels of instruction to build a foundation for geometric topics to be made into generalizations and abstractions. Many explorations should be done with models, blocks, geoboards, graph paper and computer programs. Students should observe shapes and their functions in their world.

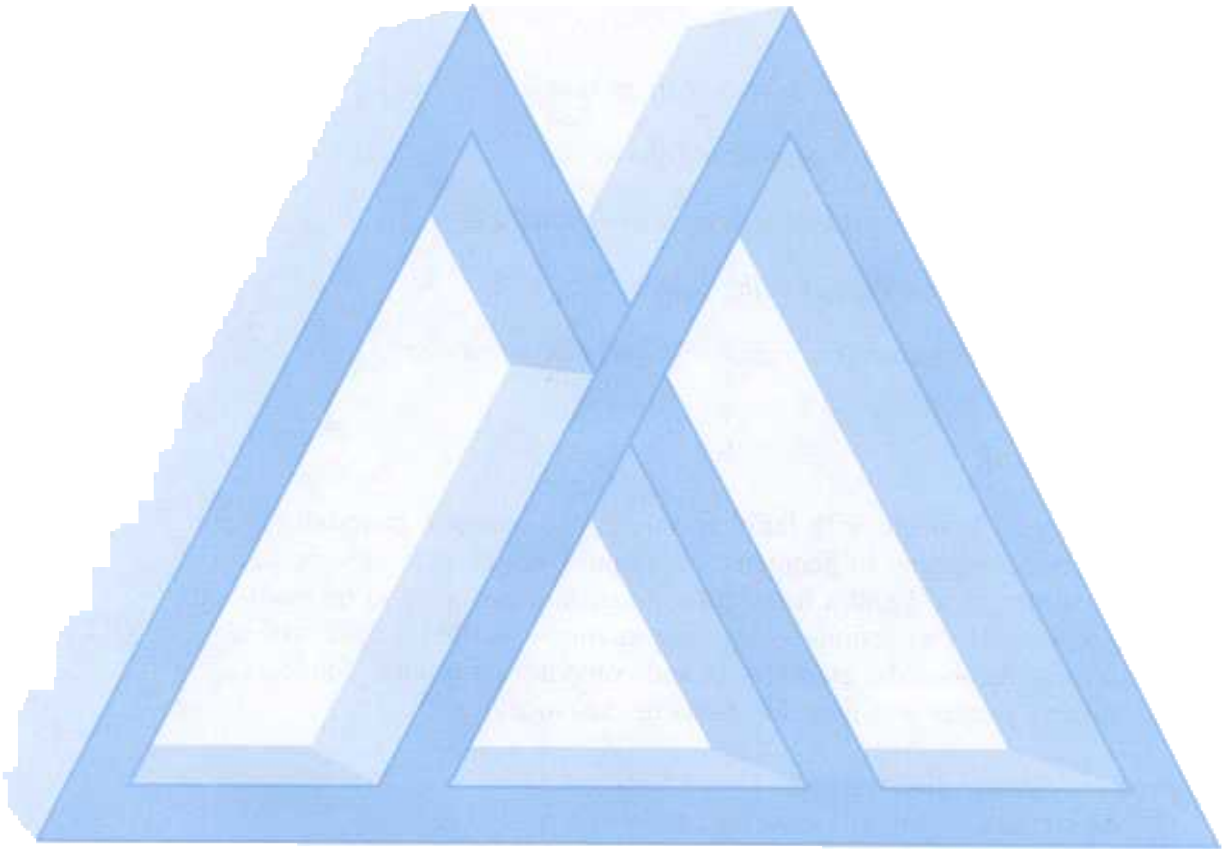
Primary Sample Investigation
Children take a geometric scavenger hunt.

Upper Elementary Sample Investigation #1
Students select, classify, and analyze logos for their geometric shapes. Design and create a geometric logo.

Upper Elementary Sample Investigation #2
Make scale models of various animals using a variety of materials. Research and discuss the environmental conditions necessary for the animals to survive.

Upper Elementary Sample Investigation #3

Use simple materials such as straws and string or toothpicks and raisins, etc. to create 3-dimensional geometric figures such as a tetrahedron (four equal triangular faces). By dipping the figure in a bubble solution, 120 degree angles are created at the tension (strength) points. Students can explore nature for the presence of other 120 degree angles.



Elementary Data Analysis

In our world we are faced with overwhelming amounts of information. This information needs to be analyzed in order to discover patterns, summarize trends, and make predictions for the future. Data analysis includes graphing, statistics, and probability. Students should develop methods to collect, organize, display, interpret data, and explore concepts of probability.

Measurable Performances

The learner will:

- *Collect, organize, and describe data.*
- *Analyze data and interpret displays of data.*
- *Predict outcomes by investigation and analysis of patterns and trends in data.*
- *Explore concepts of probability and communicate the results.*

A Closer Look

In the study of data analysis, students should use a variety of ways to gather, organize, analyze, and display information. Gathering and representing concrete objects are the beginning steps of data analysis. Initially, the discussion of the information is based only on making comparisons, such as more, less, or same as, from the graph.

After extensive experiences at a concrete level, students should begin to represent data with tallies, pictographs, bar graphs, line graphs, and Venn diagrams. Students should analyze ways to best display data. Labels, symbols, and keys are a vital part of data display. Students need to draw conclusions based on data they have collected. Student-generated ideas for data collection are appropriate and encouraged.

Connections with other disciplines can easily be made when doing data analysis; such as, analyzing data in science, exploring trends in social studies, and comparing characters in a story. While analyzing these situations, students begin to examine appropriate use of data and draw valid conclusions.

At this level, probability should be approached by predicting and exploring patterns and random events. This will allow students to build an intuitive sense of probability.

Primary Sample Investigation #1
Record daily temperatures on a calendar. Determine the highest, lowest, and most common temperature for the month. Organize and communicate the data in different ways.

Primary Sample Investigation #2
Identify attributes of food or other items such as cereals, candy, and cookies. Collect data about attributes such as color, shape, number, etc. Use pictorial or floor graphing to analyze the results.

Upper Elementary Sample Investigation #1
Analyze each student's growth by measuring foot length and height each month.

Upper Elementary Sample Investigation #2
Research and compare cost of sending a first class letter and/or packages by pony express, federal express, and/or U.S. mail. Justify your rationale for selection based upon time, cost, and other related factors.

Upper Elementary Sample Investigation #3
Using three brands of paper towels, determine which is the best buy by first determining variables. Then design an experiment to test and compare selected variables. Analyze results of computations. Use calculators to verify the students' thinking.

Elementary Patterns and Functions

Mathematics is the science of patterns. Patterns are repetitions of a sequence which are basic to the understanding of concepts in mathematics. Functions are generalizations that describe patterns. Exploring patterns and functions helps students develop mathematical power and touches every aspect of a child's life. Patterns can be found in nature, home, school, community, and classrooms. Relationships among patterns, or functions, enable students to solve problems and relate them to previous experiences and the world in which they live.

Measurable Performances

The learner will:

- ***Recognize,*** *describe, extend, analyze, and create a variety of patterns*
- ***Investigate*** *and develop relationships with charts, tables, and graphs*
- ***Transfer*** *patterns from one form to another and communicate the relationships.*

  Identify the variable, predict its effect, and explain the resulting relationships.

A Closer Look

Primary students need to focus on exploring patterns with actions, words, objects, and repetitions of sound. Seeing different forms of the same pattern helps children discover relationships. Young children should begin to make connections between concrete, pictorial, and numerical patterns. This is the beginning of the bridge between concrete and abstract thinking. The upper elementary student should focus on creating and using tables for analyzing and describing patterns. Students may be able to write mathematical expressions describing patterns. In moving from the primary to the upper elementary level, the emphasis shifts from general patterns to variables and functions. Observing patterns in the relationships between variables and the resulting values help students develop an understanding of the concept of functions. A student should begin to represent a function in table, formula, and graph form. Students can examine various patterns and functions related to art, music, science, and history.

Primary Sample Investigation #1
Design and create a mini paper quilt using color, shape, direction, and size to vary the creations.

Primary Sample Investigation #2
Observe the number of legs of various animals. Determine and make a chart for the number of legs for 2, 3, 4, etc., per animal. Study the chart and discuss observations.

Upper Elementary Sample Investigation #1
Select a country and research patterns found in that culture (e.g., music, art, jewelry, flag, architecture, etc.). The country selection may be based on heritage.

Upper Elementary Sample Investigation #2
Use oscillator- or computer-generated displays to explore and discover relationships between written music and sound.

Upper Elementary Sample Investigation #3
Have students represent a pattern both geometrically and numerically, such as square numbers, triangular numbers, etc.

Upper Elementary Sample Investigation #4
Allow students to discover the pattern created by the earth's rotation by collecting sunrise/sunset data. Graph the data and predict the time of sunrise/sunset. Color string to indicate proportion of sunlight/darkness at 4 major times of year (March 21, June 21, September 23, December 22).

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- *Investigate and develop relationships with charts, tables, and graphs*
- *Transfer patterns from one form to another and communicate the relationships.*
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Elementary Algebraic Topics

In algebra, numbers and number relationships are represented by symbols. For the primary student, algebraic topics are discovered by informal exploration of patterns using manipulatives. This involves students investigating patterns in number sequences, making predictions, and communicating patterns to others. This type of practice and experience prepares children to use variables in the future. Using variables, expressions, and equations helps the upper elementary student understand and describe physical properties and their relationships.

Measurable Performances

The learner will:

- *Illustrate mathematical expressions using manipulatives.*
- *Explore and describe the use of variables and their representations.*
- *Demonstrate the use of symbols to express numerical relationships.*

A Closer Look

The key to understanding algebraic topics is the exploration of patterns through the use of manipulatives. Students should use a variety of manipulatives such as toys, cubes, and blocks to show numerical relationships.

Upper elementary students need to continue to explore algebraic topics in a concrete manner. The transition to more abstract thinking should be made by allowing students to model and describe patterns as well as physical properties.

Primary Sample Investigation #1
Explore the relationship of a variety of patterns such as rhythmic clapping and moving (ties-in with science sound unit). Represent relationships visually

Primary Sample Investigation #2
Use manipulatives to demonstrate relationships of less than, greater than, or equal to.

Upper Elementary Sample Investigation #1
Use manipulatives to model and solve various number relationships such as think of a number, add 5 to it and so forth.

Upper Elementary Sample Investigation #2

Use various numbers, operations, and relational symbols; generate true statements. This could be integrated into other disciplines. Suggested topics to use are comparing people and animal populations.